1,163,137

PATENT SPECIFICATION

1,163,137

DRAWINGS ATTACHED.

Date of Application (No. 54718/66) and filing Complete Specification: 7 Dec., 1966.

Application made in Germany (No. T30005 IXc/43b) on 11 Dec., 1965.

Application made in Germany (No. T32183 IXc/43a) on 1 Oct., 1966.

Complete Specification Published: 4 Sept., 1969.

Index at acceptance:—G1 A(20Y, 203, 205, 206, 207, 208, 21Y, 247, 248, 307, 31Y, 357, 358, 403, 407, 409, 42Y, 422, 426, 428, 43Y, 432, 436, 438, 447, 448, 457, 458, 470, 472, 480, 49X, 712, 79Y, 792, 793, 795, 798).

International Classification:—G 07 d 7/00.

COMPLETE SPECIFICATION.

Testing the Authenticity of Banknotes.

I Davi- Th...

SPECIFICATION NO. 1,163,137

By a direction given under Section 17 (1) of the Patents Act 1949 this application proceeded in the name of REGA REGELUNGS-UND STEUERUNGSTECHNIK GmbH & Co. KG., of Seligenthal-Münchshecke, Germany, a German Company.

D 118617/1

THE PATENT OFFICE

...ing the authenticity of banknotes which have been produced by simultaneous printing and include steel-gravure printed areas, comprises first means to check the registration between the printing on the two sides of the banknote, and second means to check for variations in thickness of the banknote due to the steel-gravure printing.

Most banknotes are now produced by a simultaneous printing process and include steel-gravure printed areas. This method requires expensive machinery which is not generally available to counterfeiters.

Banknotes printed in this way have two main characteristics. Firstly, the simultaneous printing includes many points on the two sides of the banknote where the printing coincides, and these points are always in precisely the same relationship due to the simultaneous printing method employed. On the other hand, notes printed by less sophisticated machinery normally shows some slight displacement between the printing on the two sides. Secondly,

... according to the present invention for checking the relative position of printing on the two sides of a banknote,

Figure 2 shows an arrangement for testing the variations in the thickness of a banknote resulting from the steel-gravure printing method,

Figure 3 shows a high-frequency resonance arrangement for measuring the thickness of a layer of ink on a banknote,

Figure 4 shows an arrangement for testing the dimensional accuracy of a banknote, and

Figure 5 shows an arrangement for measuring the light reflection from the surface of a banknote.

Referring to Figure 1, the two sides of a banknote B, which has been produced by a simultaneous printing process, are each scanned in synchronism by separate optical systems, comprising optical transmitters G and G^1, and optical receivers H and H^1. The wave form K in Figure 1 represents the electrical output supplied by say the receiver H, and after inversion to form the signal K^1, this output is added to the ref-

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International Classification:—**G 07 d 7/00.**

COMPLETE SPECIFICATION.

Testing the Authenticity of Banknotes.

I, PAUL THURNBERGER, of Austrian nationality, of Munderfing, Upper Austria, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to apparatus for testing the authenticity of banknotes.

Such apparatus may for example be used in automatic vending and money-changing machines.

According to the present invention apparatus for testing the authenticity of banknotes which have been produced by simultaneous printing and include steel-gravure printed areas, comprises first means to check the registration between the printing on the two sides of the banknote, and second means to check for variations in thickness of the banknote due to the steel-gravure printing.

Most banknotes are now produced by a simultaneous printing process and include steel-gravure printed areas. This method requires expensive machinery which is not generally available to counterfeiters.

Banknotes printed in this way have two main characteristics. Firstly, the simultaneous printing includes many points on the two sides of the banknote where the printing coincides, and these points are always in precisely the same relationship due to the simultaneous printing method employed. On the other hand, notes printed by less sophisticated machinery normally shows some slight displacement between the printing on the two sides. Secondly, the pressure of the steel-gravure printing plates results in variations in the thickness of the banknote between printed and unprinted portions. These differences may be as much as 0.04 mm in a new banknote and even in an old banknote is normally at least 0.02 mm.

An embodiment of the invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows an arrangement used in the apparatus according to the present invention for checking the relative position of printing on the two sides of a banknote,

Figure 2 shows an arrangement for testing the variations in the thickness of a banknote resulting from the steel-gravure printing method,

Figure 3 shows a high-frequency resonance arrangement for measuring the thickness of a layer of ink on a banknote,

Figure 4 shows an arrangement for testing the dimensional accuracy of a banknote, and

Figure 5 shows an arrangement for measuring the light reflection from the surface of a banknote.

Referring to Figure 1, the two sides of a banknote B, which has been produced by a simultaneous printing process, are each scanned in synchronism by separate optical systems, comprising optical transmitters G and G^1, and optical receivers H and H^1. The wave form K in Figure 1 represents the electrical output supplied by say the receiver H, and after inversion to form the signal K^1, this output is added to the ref-

erence signal I in a coincidence circuit. The output signal supplied by the receiver H' is treated in the same way, a second coincidence circuit being used. If the printing on the two sides of the banknote coincides exactly, there will be no output from either coincidence circuit, and so if an output is present the banknote is rejected as a counterfeit.

As mentioned above, the use of steel-gravure printing plates results in banknotes in which there is a difference in thickness between steel-gravure printed and unprinted areas. These variations in thickness can be sensed by sensitive measuring devices. Thus highly sensitive indicators which generate an electrical signal when a predetermined thickness is exceeded can be used for this purpose.

Alternatively, pressure-sensitive transducers with a transmission linkage which amplifies the differences in thickness may be used to generate a direct current voltage which is proportional to the thickness. Figure 2, to which reference is now made, shows such a thickness-testing arrangement. A banknote B resting on a roller A is passed by feed rollers Z under a scanner D, which, through a transmission linkage, actuates a pressure-sensitive transducer E. The voltage U_0 shown on the voltage waveform in Figure 2 corresponds to the output when there is no paper under the scanner D, U_1 corresponds to the output for printed paper and U_2 corresponds to the output for unprinted paper. The difference between U_2 and U_1 corresponds to the depth of the impression caused by the steel-gravure printing plate.

As an alternative a piezoelectric transducer may be provided. Its mode of action corresponds to that of a sound pick-up used for record reproduction. Strip extensometer-transducers can also be used.

Finally, a capacitive thickness test is also possible, this operating in the same way as is explained below in connection with the testing of the thickness of the ink layer. However, the electrodes F (Figure 3) used must be sufficiently small to adapt to the differences in impression.

As is apparent from Figure 2, the thickness-testing arrangement can also be used to carry out tests to determine the thickness of the paper and the coarseness of the surface.

When a steel-gravure printing process is used, the thickness of the ink layer of ink is at least 10 times as great as with other printing processes, so testing the thickness of the layer of ink is of particular importance in testing the authenticity of banknotes. In contrast to ink layer thickness tests which are based on optical or radioactive radiation methods, the arrangement now to be described uses a high-frequency resonance method.

Referring to Figure 3, the banknote is passed between two narrow plate-shaped electrodes which form the plates of a capacitor C of a high-frequency oscillatory circuit (L, C), the resonance frequency of which is measured. The electrodes F must be small in order to be able to follow changes in thickness caused by the presence of ink on the surface of the banknote. It is desirable for the resonance of the oscillatory circuit to be adjusted against a genuine banknote. If the resonant frequency diverges by more than a predetermined amount the banknote B under test is rejected as counterfeit.

The banknote B is also tested for dimensional accuracy and absence of damage. This is necessary in order to detect a strip counterfeit process in which for example 20 banknotes are cut up and stuck together again to produce 21 banknotes. In the arrangement shown in Figure 4, the banknote B is positioned between an electrically conductive baseplate N and an insulated plate P having a plurality of downwardly-projecting spring-loaded contact members O, the ends of which are rounded, and which, on contact with the plate N, produce a signal. They are so arranged that, on the one hand, they indicate the periphery of the banknote B and, on the other, they scan the surface of the banknote B at various points.

Many banknotes such as, for example, Austrian banknotes, have a coating of glaze, which is largely resistant to ageing. This coating of a banknote, which can also vary other characteristics of the surface of the paper, can be utilised in order to test authenticity.

Referring to Figure 5, reflections resulting from a light beam M directed from a source L on to the surface of a banknote B may be used to check the banknote B. As illustrated, the light beam M is shone on to the surface at an angle of 45° with respect thereto. One optical receiver is arranged in a position such as to receive light reflected from the surface at an angle of 45°, to monitor the light reflected from the glossy surface, while a further optical receiver is arranged in a position at 90° with respect to the surface to measure the basic brightness of the paper. The optical receivers produce output electric signals which are compared. If specific areas of the banknote B are examined and the sensitivity of the optical receivers depends on the colour of the incident light, it is also possible to evaluate the colour of the banknote B at the area examined. Photoelectric resistances, photodiodes, phototransistors, secondary electronic multipliers and

photoelectric cells are suitable optical receivers.

A particularly simple test of the surface of the paper comprises comparing the output electric signals from the optical receivers with the electronically stored signals from a genuine banknote. For this purpose, an endless magnetic tape may for example be accommodated in the test arrangement. The output electric signals, which may be integrated are converted to a sequence of rectangular pulses of different duration. These pulses are added, in a coincidence circuit, to the inverted stored signals. In the ideal case, the resultant output is zero. If therefore the output exceeds a predetermined minimum value the banknote under test is rejected as counterfeit.

WHAT I CLAIM IS:—

1. Apparatus for testing the authenticity of banknotes which have been produced by simultaneous printing and include steel-gravure printed areas, comprising first means to check the registration between the printing on the two sides of the banknote, and second means to check for variations in thickness of the banknote due to the steel-gravure printing.

2. Apparatus according to claim 1 wherein the first means comprises first and second optical transmitters associated respectively with first and second optical receivers, the optical transmitters being arranged to scan the two sides of a banknote simultaneously and the optical receivers being arranged to supply output electric signals in dependence on light reflected from the surface of the banknote to the respective optical receiver.

3. Apparatus according to claim 1 or claim 2 wherein the second means comprises a pressure-sensitive transmitter arranged to supply an output electric signal in dependence upon variations in the thickness of the banknote.

4. Apparatus according to claim 1 or claim 2 wherein the second means comprises a piezoelectric transmitter arranged to supply an output electric signal in dependence upon variations in the thickness of the banknote.

5. Apparatus according to claim 1 or claim 2 wherein the second means comprises a strip extensometer-transmitter arranged to supply an output electric signal in dependence upon variations in the thickness of the banknote.

6. Apparatus according to claim 1 or claim 2 wherein the second means comprises a capacitive thickness measuring device arranged to supply an output electric signal in dependence upon variations in the thickness of the banknote.

7. Apparatus according to any one of the preceding claims further comprising third means to check the dimensional accuracy of the banknote.

8. Apparatus according to any one of the preceding claims further comprising fourth means to check the thickness of an ink layer on the banknote.

9. Apparatus according to claim 8 wherein the fourth means comprises a capacitive thickness measuring device arranged to supply an output electric signal in dependence upon variations in the thickness of a layer of ink on the banknote.

10. Apparatus according to any one of the preceding claims further comprising fifth means to check the reflective properties of the surface of the banknote.

11. Apparatus for testing the authenticity of banknotes which have been produced by simultaneous printing and include steel-gravure printed areas, the apparatus being substantially as hereinbefore described with reference to the accompanying drawings.

For the Applicant,
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1163137 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1.

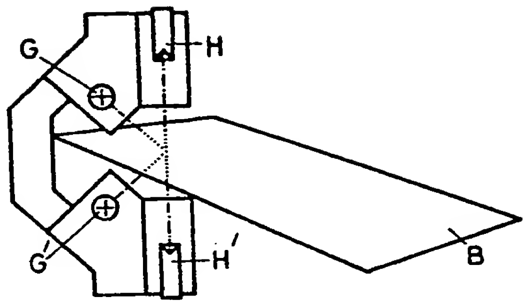
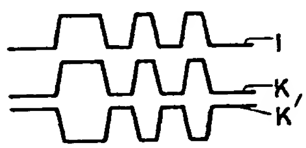


FIG. 1



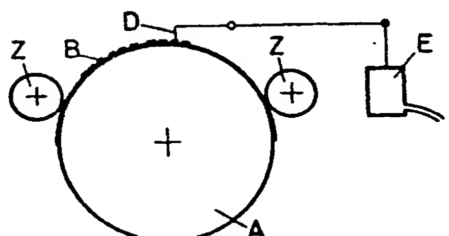
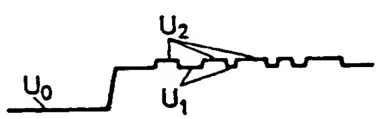


FIG. 2



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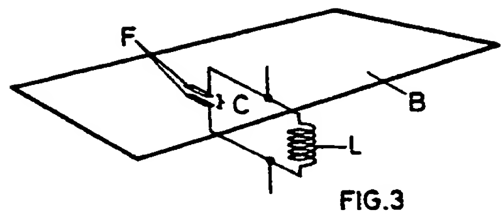

FIG.3

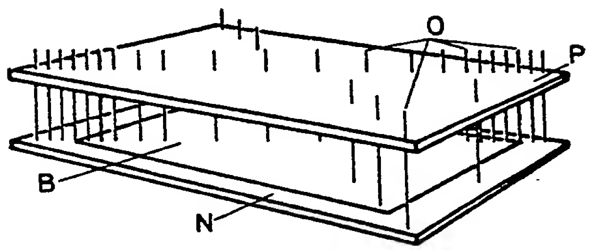

FIG.4

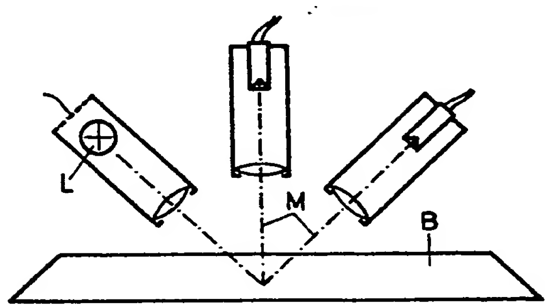

FIG.5